PATENT ABSTRACTS OF JAPAN

(11)Publication number : 07-032381
(43)Date of publicati n of appli ati n : 03.02.1995

)Int.Cl. B29C 39/10
B29C 39/22
B29C 39/36
G02B 1/04
// B29K101:10
B29L 11:00

)Application number : 05-200387
2)Date of filing : 20.07.1993

(71)Applicant : CANON INC
(72)Inventor : TOMONO HARUO
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4) MANUFACTURE OF COMPOSITE PRECISION MOLDING AND MOLDS THEREOF

7)Abstract:
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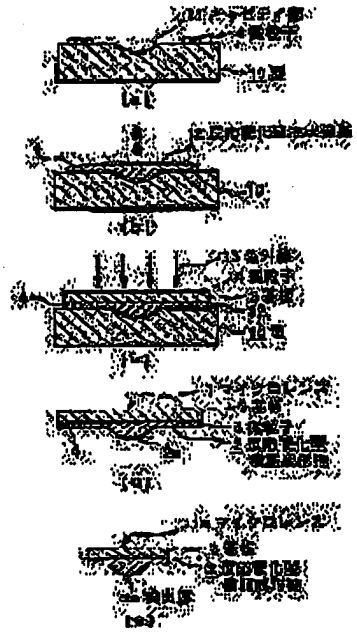

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atent number] 2844158
ate of registration] 30.10.1998
umber of appeal against examiner's decision
r jection]
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cision of rejection]
ate of extinction of right]

)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号
特開平7－32381
(43)公開日　平成7年(1995)2月3日

)Int.Cl.[6]	識別記号	庁内整理番号	ＦＩ	技術表示箇所
B29C 39/10		2126－4F		
39/22		2126－4F		
39/36		2126－4F		
G02B 1/04		7724－2K		
B29K 101:10				

審査請求　未請求　請求項の数6　ＦＤ　（全５頁）　最終頁に続く

)出願番号　特願平5－200387

)出願日　平成5年(1993)7月20日

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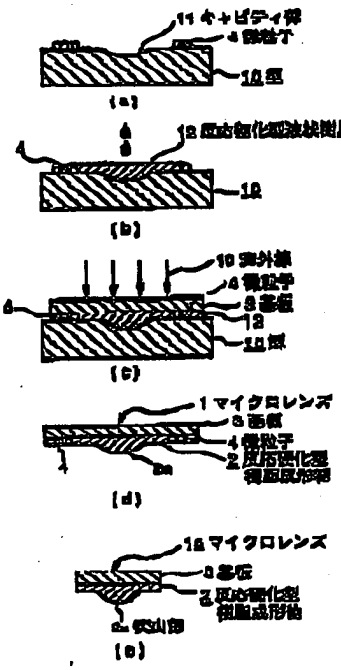
4)【発明の名称】　複合型精密成形品の製造方法およびその成形型

7)【要約】
目的】　基板に一体成形された反応硬化型樹脂成形物硬化収縮に起因する成形不良が発生しないようにす。
構成】　型１０のキャビティ部１１を囲む周辺部の４近傍に柔軟性をもつ微粒子４を少量散置する。そのの、キャビティ部１１およびそのまわりに紫外線硬化型反応硬化型液状樹脂１２を前記微粒子４に接するよう充填する。ついで透明なガラス製の基板３を重ね合わたのち、紫外線１８を照射して反応硬化型液状樹脂１を硬化させて、周辺部近傍に柔軟性をもつ微粒子４が込成形された反応硬化型樹脂成形物２を基板３に一体形する。前記反応硬化型樹脂成形物２が完全に硬化しら型１０から離型してマイクロレンズ１を得る。



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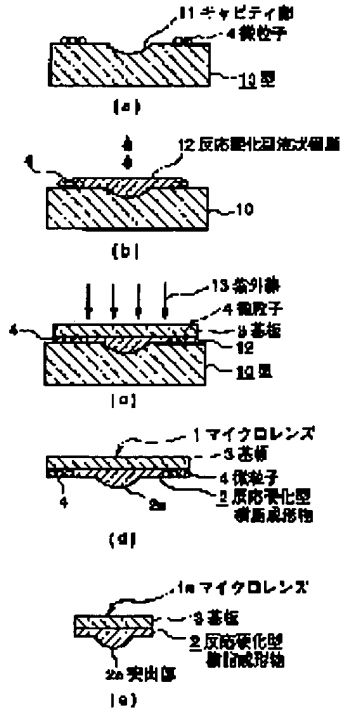
(54) MANUFACTURE OF COMPOSITE PRECISION MOLDING AND MOLDS THEREOF

(57)Abstract:

PURPOSE: To eliminate a molding defect due to curing shrinkage in a reaction curable resin molded form integrally molded with a board.

CONSTITUTION: Small amounts of fine particles 4 having flexibility are placed near four corners of a periphery for surrounding a cavity 11 of molds 10. Then, ultraviolet reaction curable liquidlike resin 12 is so filled in the cavity 11 and its periphery as to be brought into contact with the particles 4. After a transparent glass board 3 is superposed, it is emitted with an ultraviolet ray 13 to cure the resin 12, and the resin in which the particles 4 having flexibility are embedded and molded near a periphery is molded integrally with the board 3. After the resin molding 2 is completely cured, it is released from the molds 10 to obtain a microlens 1.



LEGAL STATUS

[Date of request for examination] 29.08.1996

[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	2844158
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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the manufacture method of the compound-die precision mold goods used for optics, such as a minor diameter aspheric lens, a micro lens, a lens array, and a diffraction grating, the precision parts with which a highly precise dimensional accuracy is demanded, and its form block.
[0002]
[Description of the Prior Art] Conventionally, the method explained below is proposed as the manufacture method of the compound-die optic which really fabricated the hardened material of an optical hardening type resin or a heat-hardened type resin to the glass substrate.
[0003] (b) The method of being activated to the organic compound by processing the front face of a glass substrate by silane coupling material, and carrying out the polymerization of the half-polymerization object of the aforementioned organic macromolecule, after piling up this glass substrate and a mold with a desired configuration through the half-polymerization object of a transparent organic macromolecule (refer to JP,54-6006,A).
[0004] (b) How to repeat the forming cycle released from mold after carrying out a mold clamp with an aspheric surface type object from the aforementioned activity energy-line hardening type resin side after supplying a liquefied activity energy-line hardening type resin to the front face of a lens base material, and stiffening the aforementioned activity energy-line hardening type resin by irradiation of an activity energy line subsequently twice [at least] (refer to JP,1-171932,A).
[0005]
[Problem(s) to be Solved by the Invention] however, among the above-mentioned Prior arts, a (b) has the trouble that poor forming which are HIKE, distortion, cellular mixing, etc. occurs by the volumetric shrinkage resulting from hardening contraction of an organic macromolecule, when fabricating the micro lens whose outer diameter are 100micro or more, the large thing, for example, the main thickness, of thickness deflection of an organic macromolecule layer, and is about 0.2-several mm to a substrate
[0006] Moreover, since it is necessary to repeat the above forming cycles of the thing which it stops generating twice [at least], and to perform them, and the operating frequency of an expensive aspheric surface type object is high and the quantity of poor forming resulting from the volumetric shrinkage in which the (b) mentioned above has a (b) per aspheric surface type object which can be fabricated decreases while starting fabrication for a long time, there is a trouble that a manufacturing cost becomes high.
[0007] this invention is made in view of the trouble which the above-mentioned Prior art has, and the manufacture method of the highly precise compound-die precision mold goods which poor forming, such as HIKE resulting from hardening contraction, distortion, and cellular mixing, does not generate in the reaction hardening type resin moldings really fabricated by the substrate, and its form block are realized -- it aims at things
[0008]

· [Means for Solving the Problem] In order to attain the above-mentioned purpose, the manufacture method of the compound-die precision mold goods of this invention It is the manufacture method of the compound-die precision mold goods which really fabricate a reaction hardening type resin moldings to a substrate. The form block which prepared the cavity section of the configuration reversed to the configuration of the aforementioned reaction hardening type resin moldings is used. Before the process which lays the particle which has flexibility near the periphery of the field in which the cavity section of the aforementioned form block was prepared, or to the back Fill up the aforementioned cavity section with a reaction hardening type liquefied resin, pile up a substrate on the back aforementioned reaction hardening type liquefied resin, and this is covered. Subsequently, after the aforementioned particle really fabricates to a substrate the reaction hardening type resin moldings by which embedded fabrication was carried out near the periphery by stiffening the aforementioned reaction hardening type liquefied resin, it is characterized by releasing this from mold from the aforementioned form block.
[0009] Moreover, in the above-mentioned manufacture method, a particle with the flexibility near the periphery of the reaction hardening type resin moldings really fabricated by the substrate excises with a substrate the portion by which embedded fabrication is carried out after mold release.
[0010] Furthermore, for the particle with flexibility, an elastic modulus is 1x105 kg/cm2. It is effective, if it shall consist of the following material or is particle size 1 or a 1000micro abbreviation spherical particle.
[0011] The form block of the compound-die precision mold goods used for implementation of the manufacture method of the above-mentioned compound-die precision mold goods The cavity section of the configuration which is the form block used for the manufacture of compound-die precision mold goods which really fabricates a reaction hardening type resin moldings at a substrate, and was reversed to the configuration of the aforementioned reaction hardening type resin moldings, It is characterized by protruding the height of height smaller than the particle size of the aforementioned particle for carrying out fixed maintenance of the position with the flexibility laid near the periphery of the field in which the aforementioned cavity section was prepared of a particle.
[0012]
[Function] In order that the particle which has the flexibility by which embedded fabrication is carried out near the periphery of a reaction hardening type resin moldings may balance and deform into the amount of volumetric shrinkages resulting from hardening contraction of a reaction hardening type resin and a substrate and a form block may approach, poor forming, such as HIKE, distortion, and cellular mixing, does not occur.
[0013]
[Example] The example of this invention is explained based on a drawing.
[0014] Drawing 1 is explanatory drawing showing each process of the 1st example of the manufacture method of compound-die precision mold goods.
[0015] If the form block used before explanation of a process is explained, as shown in drawing 1 , a mold 10 consists of glass, a metal, plastics, etc., it has the cavity section 11 of the configuration reversed to the configuration of the micro lens 1 which is compound-die precision mold goods, and a predetermined optical-surface precision is made to this cavity section 11 by polish, cutting, etc.
[0016] ** As shown in (a) of drawing 1 , carry out little installation of the particle 4 which has flexibility near the 4 corners of the periphery surrounding the cavity section 11 of a mold 10.
[0017] ** As shown in (b) of drawing 1 after it, it is filled up with the ultraviolet-rays hardening type reaction hardening type liquefied resin 12 using a dispenser etc. the cavity section 11 and around it so that it may touch to the particle 4 with flexibility.
[0018] ** Irradiate ultraviolet rays 13, stiffen the aforementioned reaction hardening type liquefied resin 12, and really fabricate the reaction hardening type resin moldings 2 with which embedded fabrication of the particle 4 which has flexibility near the periphery was carried out to a substrate 3, after piling up the transparent glass substrate 3 so that the illustration upper surface of the aforementioned ultraviolet-rays hardening type reaction hardening type liquefied resin 12 may be worn so that it may be shown subsequently to (c) of drawing 1 . Although hardening contraction takes place to the aforementioned

reaction hardening type resin moldings 2 at this time, in order that the particle 4 with the aforementioned flexibility may act like a spacer, as shown in drawing 4 , it is pressed with a substrate 3 and a mold 10, and deforms, and, only in the distance corresponding to the amount of volumetric shrinkages by the aforementioned hardening contraction, a substrate 3 and a mold 10 approach. For this reason, poor forming, such as HIKE, does not occur in the aforementioned reaction hardening type resin moldings 2.
[0019] ** After the process of the above-mentioned **, if the aforementioned reaction hardening type resin moldings 2 hardens completely, the micro lens 1 which releases from mold from a mold 10 and is shown in (d) of drawing 1 will be obtained.
[0020] ** If the portion by which embedded fabrication of the aforementioned particle 4 near the periphery of after the process of ** and the reaction hardening type resin moldings 2 is further carried out depending on the case is excised with a substrate 3, micro-lens 1a with good appearance as shown in (e) of drawing 1 can be obtained.
[0021] Next, the 2nd example of the above-mentioned manufacture method is explained.
[0022] As this modification performs conversely the process of the above-mentioned ** in each process of the manufacture method shown in above-mentioned drawing 1 , and the process of the above-mentioned ** and shows them to (a) of drawing 2 After filling up the cavity section 21 of a mold 20, and its periphery with the liquefied ultraviolet-rays hardening type reaction hardening type liquefied resin 22, as shown in (b) of drawing 2 As four corners of the periphery of the aforementioned reaction hardening type resin 22 of the periphery of the cavity section 21 are touched, it is only differing in that a particle 4 is laid, and since the process shown in (c) of subsequent drawing 2 or (e) is the same as the process of the above-mentioned ** or **, explanation is omitted.
[0023] In this invention, the particle which has flexibility can use various well-known inorganic material and an organic material.
[0024] When an elastic modulus (E) is used as an index, two or less 1x105 kg/cm is desirable, and the flexibility is 0.5x105 kg/cm2. The following is more desirable. As a test method of this elastic modulus, D638, D743, D747, etc. of the standardized method, for example, ASTM specification, ("plastics handbook" 1969 Asakura Publishing Co., Ltd. p.669 - 679 reference) are used suitably.
[0025] An elastic modulus is 1x105 kg/cm2. If it is above, the effect which absorbs the amount of volumetric shrinkages by the hardening contraction mentioned later by the particle with flexibility will fade, and which poor forming with an imprint poor as a result will arise. An elastic modulus is 1x105 kg/cm2. A synthetic-macromolecule material well-known as a material with the following flexibility of a particle is used suitably.
[0026] As a synthetic-macromolecule material, for example Styrene, a vinyl chloride, acrylonitrile, The homopolymer and/or copolymers of a vinyl system monomer, such as vinyl acetate, acrylic esters, and methacrylic esters, Butadiene system copolymers, such as a styrene-butadiene copolymer and a methyl methacrylate-butadiene copolymer, Olefin system resins, such as polyethylene and polypropylene, a polyamide, Thermoplastics, such as a polycarbonate, a polytetrafluoroethylene, and silicon resin Elastomer resins, such as thermosetting resin, such as phenol resin, an epoxy resin, and a urethane resin, butadiene rubber, a nitrile rubber, an acrylic rubber, and silicone rubber, are raised, and the elastic modulus of an above-mentioned typical resin is well-known.
[0027] As a configuration, although what thing is sufficient as the shape of a sphere, an ellipse sphere, a cube, a rectangular parallelepiped, a circular cone, and an anomaly etc., the shape of a globular form of a dimensional accuracy is good, and that to which the dimensional accuracy is equal is easy to come to hand easily.
[0028] As a size, in order that the particle size of about 1-1000 micrometers may maintain forming precision, for example in the case of an abbreviation spherical particle, it is desirable. That is, by 1 micrometer or less, since the layer of a reaction hardening type resin becomes thin too much, the volumetric shrinkage resulting from the hardening contraction mentioned later cannot be absorbed, poor forming arises, in 1000 micrometers or more, the absolute magnitude of a reaction hardening type resin becomes large, the absolute magnitude of contraction volume also becomes large in connection with it, and the absorption effect by the particle fades. The particle size of 10-500 micrometers is preferably

good.
[0029] Furthermore, appearance will become good if the refractive index of a particle and a reaction hardening type resin moldings with flexibility chooses an equal material.
[0030] As a reaction hardening type liquefied resin, an ultraviolet-rays hardening type liquefied resin and in addition to this, a heat-hardened type or room-temperature-setting type epoxy resin silicon resin, polyester, polyurethane, etc. may be used, and activity energy lines other than ultraviolet rays, for example, infrared radiation, a visible ray, an electron ray, an X-ray, etc. may be used. As a resin material, the mixed constituent which blended the single constituent or several sorts of monomers which mixed the optical initiator is raised to acrylic monomers, such as urethane acrylate, epoxy acrylate, polyester acrylate, and polyether acrylate, epoxy, silicon, polyester, an urethane system monomer, etc.
[0031] Moreover, as a substrate, a glass plate, a metal plate, a plastic sheet, etc. can be used.
[0032] There are the method of holding and supplying to a pincette as the supply method for laying a particle with flexibility, a method of dropping from the fall mouth of a hopper, and the method of flowing out with air from a nozzle. Moreover, it replaces with these methods, and if the method of trickling the mixture which mixed the particle 4 which has flexibility in a reaction hardening type liquefied resin beforehand is adopted using the 2nd dispenser 100 other than the dispenser mentioned above as shown in drawing 3 , the handling of a particle 4 will become simple.
[0033] Furthermore, since the inclination of a substrate does not occur but the thickness of a reaction hardening type liquefied resin layer becomes uniform when it was about four places like [it is desirable and] drawing 1 and a substrate is covered and put that what is necessary is [several / beyond it / 2 on the diagonal line on the field in which the cavity section of a mold was formed centering on a cavity, or] just at least, the position in which a particle with flexibility is laid is desirable.
[0034] Here, the modification of the form block of the compound-die precision mold goods concerning this invention is explained.
[0035] What protruded height 200a of Yamagata of height smaller than the particle size of a particle 4 which has flexibility near the periphery of the field in which the cavity section 201 of the mold 200 shown in (a) of drawing 5 was formed, That in which the upper surface of the couple of height smaller than the particle size with the flexibility which set the interval and protruded near the periphery of the field in which the cavity section 301 of the mold 300 shown in (b) of drawing 5 was formed of a particle 4 formed the flat heights 300a and 300b, There are some in which the upper surface of height smaller than the particle size of a particle 4 which has flexibility near the periphery of the field in which the cavity section 401 of the mold 400 shown in (c) of drawing 5 was formed prepared flat height 400a. These heights 200a, 300a, 300b, and 400a can carry out fixed maintenance of the aforementioned particle 4 correctly by preparing in the part which should lay the particle 4 with flexibility, respectively.
[0036] As compound-die mold goods concerning this invention, in addition to the micro lens of each above-mentioned example To the substrate 33 shown in (a) of drawing 6 , a concavo-convex recurrence configuration The reaction hardening type resin moldings 32 which it has The reaction hardening type resin moldings 52 which has the lobe of the shape of much semi-sphere in the really fabricated diffraction grating 31, the blazed grid 41 which really fabricated the reaction hardening type resin moldings 42 which has the recurrence configuration of Yamagata in the substrate 43 shown in (b) of drawing 6 , and the substrate 53 shown in (c) of drawing 6 There is a really fabricated lens array 51.
[0037] moreover, in addition to this To the substrate 63 shown in (a) of drawing 7 , one Yamagata configuration The reaction hardening type resin moldings 62 which it has The slot article 71 for ink nozzles of the printer which really fabricated the reaction hardening type resin moldings 72 which has a quirk configuration in the really fabricated reflecting prism 61 and the substrate 73 shown in (b) of drawing 7 , and the reaction hardening type resin moldings 82 which has one crevice in the substrate 83 which shows (c) of drawing 7 There is part 91 grade which has a reaction hardening type resin moldings in both sides of the substrate which really fabricated the reaction hardening type resin moldingses 82a and 82b, respectively to both sides of the really fabricated concave lens 81 and the substrate 83 shown in (d) of drawing 7 .
[0038] (Example 1) The type quality of the material was made into phosphor bronze, and the mold as

the diameter of 1.8mm, the radius of curvature of 1.6mm, and profile irregularity show to drawing 1 of the one or less Newton ring was created by the precision cutting method.
[0039] Next, the polystyrene particle (product [made from Duke] and tradename:polystyrene DVB and elastic-modulus:3.5x104 kg/cm2) with a particle size of 100 micrometers was installed 10-20 pieces near [four] the periphery, as dropping restoration was carried out at the cavity circles of a mold, and its periphery as shown in (a) of drawing 2 , and the urethane acrylate system ultraviolet-rays hardening type liquefied resin whose viscosity is 3500cps was further shown in (b) of drawing 2 . A glass substrate with a thickness of 1mm is covered on it after it by the transparence which was beforehand pretreated by the silane coupling agent in the front face and which was carried out, and illuminances are 30 mw/cm2. Ultraviolet rays were irradiated for 2 minutes and the aforementioned resin was stiffened.
[0040] Next, it released from mold and the micro lens which is compound-die mold goods as shown in (d) of drawing 2 was obtained. When profile irregularity was measured, it is one Newton and good imprint nature was shown.
[0041] (Example 2) The type quality of the material was made into aluminum, and the mold with the reversal configuration of the shape of a quirk as shown in (b) of drawing 7 whose length a cross-section configuration is 200-micrometer angle, and is 10mm was created by the precision cutting method.
[0042] Next, dropping restoration of the same ultraviolet-rays hardening type liquefied resin as an example 1 was carried out at the cavity circles of a mold, and its periphery, further, the bridge formation polymethylmethacrylate particle was classified and the particle (elastic modulus : 3.2x104 kg/cm2) with the flexibility of 300 micrometers of mean particle diameters which were obtained by carrying out was installed in four peripheries 10-20 pieces. A glass substrate with a thickness of 1mm is covered on it by the transparence beforehand pretreated by the silane coupling agent in the front face, and illuminances are 30 mw/cm2. Ultraviolet rays were irradiated for 2 minutes and the aforementioned resin in a cavity was stiffened.
[0043] Next, it released from mold and the slot article for ink nozzles of the printer which is compound-die mold goods as shown in (b) of drawing 7 was obtained. It turns out that good imprint nature is shown by surface observation under a microscope.
[0044] The completely same mold as an example 1 and an ultraviolet-rays hardening type liquefied resin are used. (Example 1 of comparison) As shown in (a) of drawing 8 , dropping restoration of the aforementioned resin 502 is filled to the inside of the cavity section 501 of a mold 500. A front face is beforehand worn with the glass substrate 503 with a thickness of 1mm by the transparence pretreated by the silane coupling agent, and as shown in (b) of drawing 8 , they are 30 mw/cm2. It released from mold by having irradiated ultraviolet rays 504 for 2 minutes, and the compound-die convex lens 505 of drawing 8 as shown in (c) was obtained. When generating with poor HIKE was observed in the lens side and profile irregularity was measured, it was 20 or more Newton and imprint nature was bad.
[0045] (Example 2 of comparison) using the completely same mold as an example 2, and the ultraviolet-rays hardening type liquefied resin, dropping restoration of this was filled to the cavity circles of a mold, and the front face was beforehand pretreated by the silane coupling agent -- transparent -- a glass substrate with a thickness of 1mm -- covering -- 30 mw/cm2 It released from mold by having irradiated ultraviolet rays for 2 minutes, and the slot article for ink nozzles of a printer as shown in (b) of drawing 7 was obtained. Generating with poor HIKE with a diameter of about 0.2mm was partly observed by the surface observation under a microscope, and it was shown that imprint nature is bad.
[0046] (Example 3 of comparison) Using the completely same mold as an example 2, and the ultraviolet-rays hardening type liquefied resin, dropping restoration of this resin was carried out at the cavity circles of a mold, and its periphery, and the particle (elastic modulus : 7.0x105 kg/cm2) of 300 micrometers of mean particle diameters obtained by classifying a soda lime glass particle was further installed in four mold peripheries 10-20 pieces. Subsequently, a front face is beforehand worn with a glass substrate with a thickness of 1mm by the transparence pretreated by the silane coupling agent, and it is 30 mw/cm2. It released from mold by having irradiated ultraviolet rays for 2 minutes, and the slot article for ink nozzles of a printer as shown in (b) of drawing 7 was obtained. Much generating with poor HIKE with a diameter of about 0.1mm was observed by the surface observation under a

microscope, and it was shown that imprint nature is bad.

[0047]

[Effect of the Invention] Since according to this invention poor forming, such as HIKE resulting from hardening contraction of a reaction hardening type resin, distortion, and cellular mixing, does not occur in the fabricated compound-die precision mold goods but it has a good imprint precision, even if it is compound-die precision mold goods with the large reaction hardening type resin moldings of thickness change, it can manufacture often [precision] and easily.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is explanatory drawing showing each process of the 1st example of the manufacture method of the compound-die precision parts of this invention.
[Drawing 2] It is explanatory drawing showing each process of the 2nd example of the manufacture method of the compound-die precision parts of this invention.
[Drawing 3] It is explanatory drawing showing an example of the supply method with flexibility of a particle.
[Drawing 4] It is explanatory drawing showing the volumetric-shrinkage absorption principle of a particle with the flexibility over the hardening contraction in this invention.
[Drawing 5] It is the ** type fragmentary sectional view showing the principal part of the modification of the form block concerning this invention.
[Drawing 6] It is the type section view showing other examples of the compound-die precision parts concerning this invention.
[Drawing 7] It is the type section view showing other examples of the compound-die precision parts concerning this invention.
[Drawing 8] It is explanatory drawing showing the process of the manufacture method of the conventional compound-die mold goods.
[Description of Notations]
1 1a Micro lens
2 32 Reaction hardening type resin moldings
3 Substrate
4 Particle
10 20,200,300,400 Type
11 21,201,301,401 Cavity section
12 22 Reaction hardening type liquefied resin
100 2nd Dispenser
200a, 300a, 300b, 400a Height

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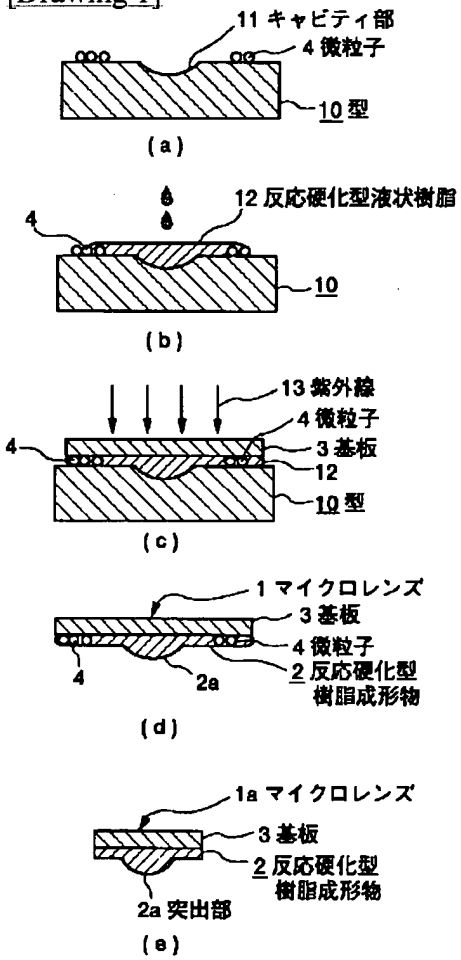
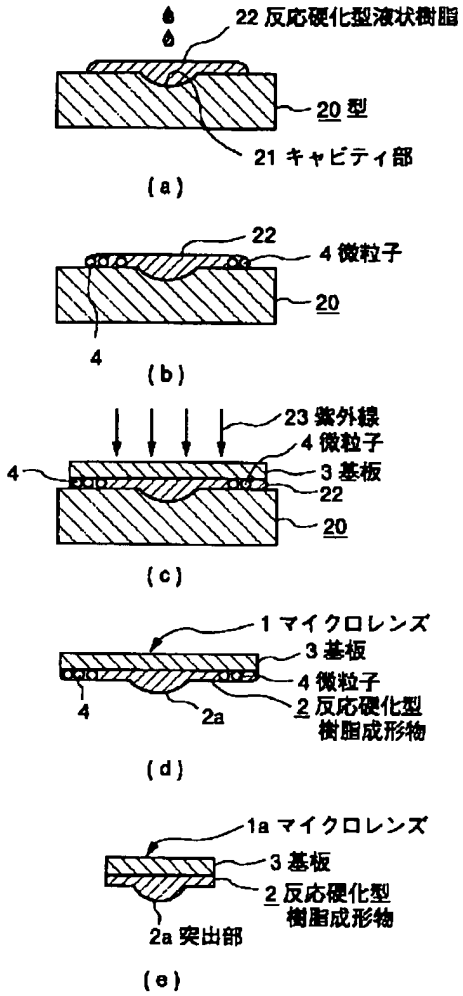
DRAWINGS

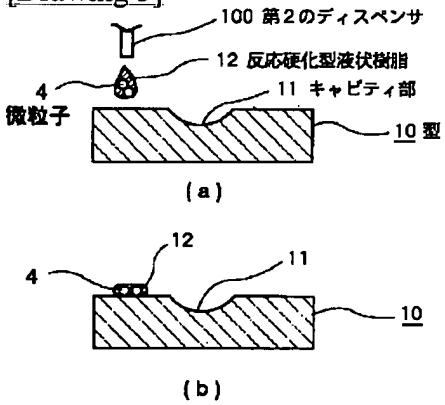
[Drawing 1]



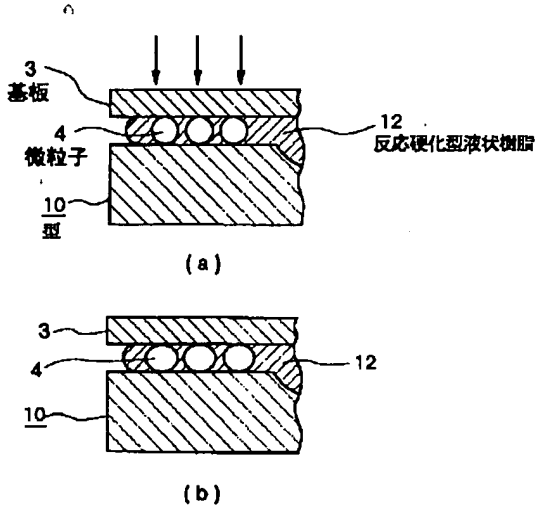
[Drawing 2]



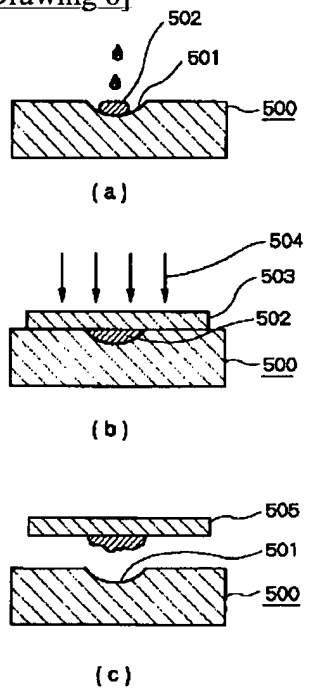
[Drawing 3]



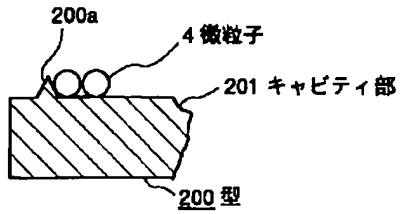
[Drawing 4]



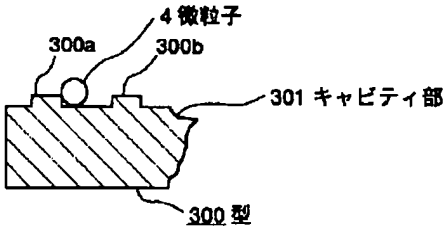
[Drawing 8]



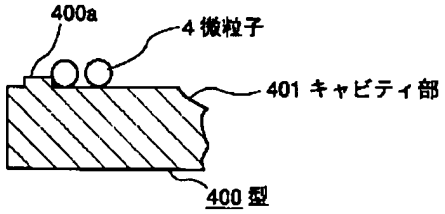
[Drawing 5]



(a)

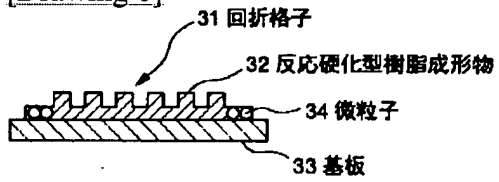


(b)

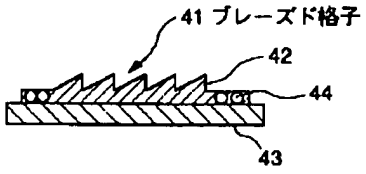


(c)

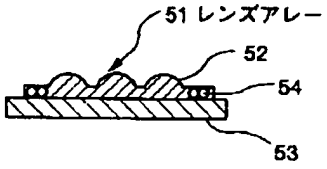
[Drawing 6]



(a)

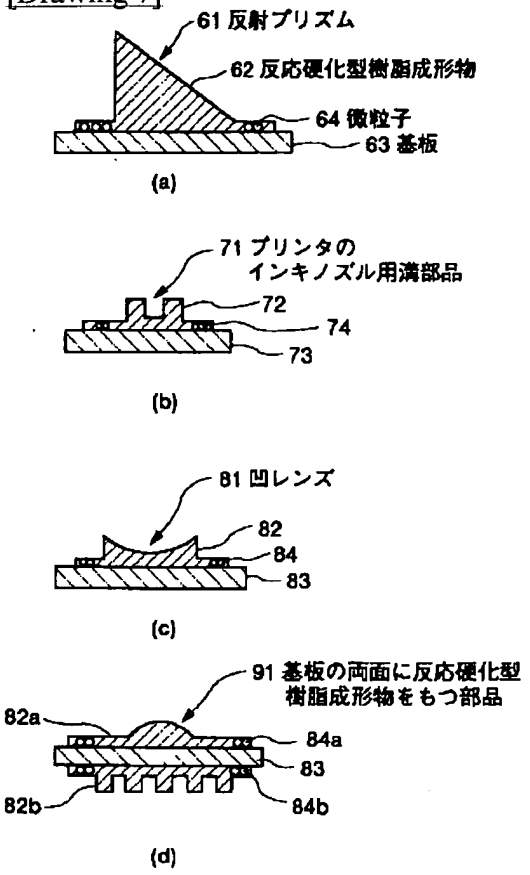


(b)



(c)

[Drawing 7]



[Translation done.]